



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/905,027	07/13/2001	Harold G. Craighead	1153.032US1	2231

21186 7590 08/28/2003

SCHWEGMAN, LUNDBERG, WOESSNER & KLUTH, P.A.
P.O. BOX 2938
MINNEAPOLIS, MN 55402

EXAMINER

TRINH, MICHAEL MANH

ART UNIT	PAPER NUMBER
----------	--------------

2822

DATE MAILED: 08/28/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/905,027

Applicant(s)

CRAIGHEAD ET AL.

Examiner

Michael Trinh

Art Unit

2822

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 29 May 2003.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-32 and 34-50 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 24 is/are allowed.
- 6) ☒ Claim(s) 1-7, 9-18, 20-23, 25-32 and 34-50 is/are rejected.
- 7) ☒ Claim(s) 8 and 19 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 14.
- 4) ☐ Interview Summary (PTO-413) Paper No(s) _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

Art Unit: 2822

DETAILED ACTION

*** This office action is in response to Applicant's amendment and RCE filed on May 29, 2003. Claim 33 was canceled. Claims 1-32, and 34-51 are current pending.

*** Applicant is advised that the numbering of claims is not in accordance with 37 CFR 1.126 which requires the original numbering of the claims to be preserved throughout the prosecution. When claims are canceled, the remaining claims must not be renumbered. When new claims are presented, they must be numbered consecutively beginning with the number next following the highest numbered claims previously presented (whether entered or not).

Under 37 CFR 126 Rule, since there is no claim 40 in the amendment filed May 29, 2003, misnumbered claims 1-39 and 41-51 have been renumbered as 1-39 and 40-50, respectively. Renumbered claims 1-39 and 40-50 are mentioned hereafter. \

*** The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

*** Abstract is apparently missing and not included in the application. Applicant is respectfully requested to provide a copy of the original abstract in response to this office action.

*** Claim 24, line 6, is objected as including typing error. The term "bay" should be --by--.

Claim Rejections - 35 USC § 112

1. Claim 25,26,47, 50 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Re claim 25 and 47, meaning and scope of "...surface effects are significant factors in fluid flow..." are unclear and indefinite for how significant factors it is?.

Re claim 50, meaning and scope of "a low conformality deposition process" are unclear and indefinite for how low it is?.

Art Unit: 2822

(Dependent claim 26 is rejected as depending on rejected base claim 25)

Claim Rejections - 35 USC § 102

2. Claims 1-2,20-22,25-26,42,49 are rejected under 35 U.S.C. 102(e) as being anticipated by Tai et al (6,146,543).

Tai et al disclose a method comprising the steps of: depositing a floor layer 340 on the top surface of a substrate (Figs 3A-3G; col 4, line 10 through col 5); depositing a silicon sacrificial layer 333 on the top surface of the floor layer (col 4, lines 24-30; Figs 3B-3G), wherein the sacrificial layer defines nanometer scale flowchannels such that surface effects are significant factors in fluid flow through such flow channels, inherently; patterning the silicon sacrificial layer to define a shape of a desired fluid working gap; depositing a ceiling layer 343 to cover the silicon sacrificial layer (Figs 3C); and removing the silicon sacrificial layer 333 from between the floor layer and the ceiling layer to produce the working gap (Fig 3G). Re claim 2, the step of providing at least one recess hole leading to the sacrificial layer, and etching the sacrificial layer through the at least one recess hole (Fig 3G). In re claims 20-22, wherein the device on the substrate that allows fluid transfer between working gaps and device (Fig 3G) and is fabricated in a process compatible with process of forming a working gap. Re claim 49, wherein the sacrificial layer 330/333 is deposited by CVD (col 4, lines 10-30).

Claim Rejections - 35 USC § 103

3. Claims 1-4,20-22,25-26,27,28,30-32,34,37-39,42-43,49-50 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mastrangelo et al (6,136,212) and Tai et al (6,146,543) and in view of and further of Lin et al (5,591,139).

Mastrangelo et al also disclose a method comprising the steps of: depositing a floor layer on the top surface of a substrate (col 5, lines 57-66); depositing a sacrificial layer on the top surface of the floor layer (col 5, line 67 through col 6, line 3); patterning the sacrificial layer to define a shape of a desired fluid working gap (col 5, line 67 through col 6, line 3), wherein the sacrificial layer defines nanometer scale flowchannels, as 1000nm equals 1 micron, such that surface effects are significant factors in fluid flow through such flow channels, inherently; depositing a ceiling layer to cover the sacrificial layer (col 6, lines 3-5); and removing the sacrificial layer from between the floor layer and the ceiling layer to produce the working gap

Art Unit: 2822

(col 6, lines 8-10). Re claim 2, the step of providing at least one recess hole leading to the sacrificial layer, and etching the sacrificial layer through the at least one recess hole (col 6, lines 5-9). In re claims 20-22, wherein the device on the substrate that allows fluid transfer between working gaps and device (col 7, lines 5-12; Fig 6) and is fabricated in a process compatible with the process of forming a working gap (col 6, lines 36-38, 62-63). Re claim 49, wherein the sacrificial layer 330/333 is deposited by CVD (col 4, lines 10-30).

Mastrangelo fails to disclose an access hole formed through the ceiling layer through the ceiling layer to sacrificial layer of silicon and a sealing layer deposited over the ceiling layer to close the access hole. Mastrangelo also fails etching the sacrificial layer using tetramethyl ammonium hydroxide.

Tai et al disclose the ceiling layer comprising a dielectric material and the sacrificial layer comprising polysilicon (col 4, lines 12-33). Lin et al disclose an access hole formed through the ceiling layer to sacrificial layer (col 6, lines 8-11) and a sealing layer deposited over the ceiling layer to close the access hole (col 6, lines 40-43), wherein the sealing layer is inherently deposited by a low conformality deposition process. Tai et al also disclose an etchant comprising tetramethyl ammonium hydroxide (col 5, lines 5-35).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to recognize to substitute of polysilicon, as these materials are alternative for use as a sacrificial material, in modifying the ceiling and sacrificial layers of Mastrangelo to make the ceiling layer out of a dielectric material and the sacrificial layer out of polysilicon as taught by Tai et al in order to have a high fracture strain, low modulus material for the ceiling layer and to have a sacrificial layer that has a etch high selectivity over the ceiling layer. It also would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the method of Mastrangelo to form an access hole in the ceiling layer and to deposit a sealing layer on the ceiling layer in order to close the access hole as taught by Lin et al because the formation of the access hole through the ceiling layer are easier to seal and the sealing layer is needed to seal the access hole in order to fabricate a sealed device. It also would have been obvious to one of ordinary skill in the art at the time the invention was made to substitute amorphous silicon for polysilicon, as these materials are alternative for use as a sacrificial material.

Art Unit: 2822

4. Claims 5-7,48 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mastrangelo et al (6,136,212), as applied above to claim 1, and further of Mastrangelo (5,258,097).

Mastrangelo et al '212 disclose a method for fabricating a fluidic system as applied above.

Mastrangelo '212 fails to disclose the multiplicity of holes extending through the sacrificial layer to the floor layer, depositing of the ceiling layer in the holes to define obstacles in the working gaps; and removing of the sacrificial layer between the obstacles in the working gap to produce an artificial gel.

Mastrangelo '097 discloses the multiplicity of holes extending through the sacrificial layer to the floor layer (col 4, lines 9-17), depositing of the ceiling layer in the holes to define obstacles in the working gaps (col 2, lines 21-30; col 4, lines 35-53), and removing of the sacrificial layer between the obstacles in the working gap to produce an artificial gel (col 5, lines 45-50).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the method of Mastrangelo '212' to form the multiplicity of holes extending through the sacrificial layer to the floor layer, to deposit of the ceiling layer in the holes to define obstacles in the working gaps, and to remove of the sacrificial layer between the obstacles in the working gap to produce an artificial gel, as taught by Mastrangelo '097 in order to provide structural support for the ceiling layer against capillary forces. The subject matter as a whole would have been obvious to one of ordinary skill in the art at the time the invention was made to select the portion of the prior art's range of obstacles diameter, because it has been held to be obvious to select a value in a known range by optimization for the best results, wherein employing these specific parameters would have been obvious to one of ordinary skill in the art, since these parameters are art-recognized variables which are subjected to routine experimentation and optimization. In re Aller, et al., 105 USPQ 233; In re Waite 77 USPQ 586 (CCPA 1948), In re Sola 25 USPQ 433.

5. Claims 9-10,44-47 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mastrangelo et al (6,136,212) in view of Frazier (5,871,158).

Art Unit: 2822

Mastrangelo et al disclose a method comprising the steps of: depositing a floor layer on the top surface of a substrate (col 5, lines 57-66); depositing a sacrificial layer on the top surface of the floor layer (col 5, line 67 through col 6, line 3); patterning the sacrificial layer to define a shape of a desired fluid working gap (col 5, line 67 through col 6, line 3); depositing a ceiling layer to cover the sacrificial layer (col 6, lines 3-5); and removing the sacrificial layer from between the floor layer and the ceiling layer to produce the working gap (col 6, lines 8-10), wherein the sacrificial layer defines nanometer scale flowchannels such that surface effects are significant factors in fluid flow through such flow channels, inherently.

Mastrangelo fails to disclose the addition of a patterned sacrificial layer, a second ceiling layer, and the removal of the sacrificial layer to produce multilevel working gaps of fluidic channels.

Frazier discloses the formation of working gaps on multilevel having a plurality of flow fluidic channels of similar in size (Fig 8, col 7, lines 30-41).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the method of Mastrangelo '212' to form multilevel as taught by Frazier to allow different fluids to flow through different channels, wherein the channels are similar in size.

6. Claims 11-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mastrangelo et al (6,136,212) and Frazier (5,871,158), as applied above to claim 9, and further of Lin et al (5,591,139).

Mastrangelo '212 and Frazier disclose a method for fabricating a fluidic system as applied above to claim 9, wherein the method comprises forming a multilevel fluidic device and the depositing of a sealing layer over the second sealing layer to close at least one access hole.

Mastrangelo et al fails to disclose the removing of sacrificial layers performed by etching all the sacrificial layers through at least one access hole formed in the ceiling layer, including the formation of the access hole through the topmost ceiling layer, leading to one of the sacrificial layers and at least one vertical connector hole that interconnects adjacent sacrificial layers.

Mastrangelo also fails to disclose the depositing of a sealing layer over the second ceiling layer to close the one access hole.

Art Unit: 2822

Lin et al disclose the removing of the sacrificial layer performed by etching the sacrificial layer through at least one access hole (col 6, lines 9-11), including the formation of the access hole through the topmost ceiling layer, leading to one of the sacrificial layers and at least one vertical connector hole that interconnects adjacent sacrificial layers (col 6, lines 8-11).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the method of Mastrangelo in order to form the access holes and vertical connector hole and to etch away the sacrificial layers as taught by Lin et al because the formation of the access holes through the ceiling layers are easier to seal and they provide access to the sacrificial layer. Furthermore duplication of a prior art process to accomplish a multilevel structure that would have access holes formed in every ceiling layer thus deposited would have been obvious to one of ordinary skill in the art at the time the invention was made.

7. Claims 16-18,41-42 are rejected under 35 U.S.C. 103(a) as being unpatentable over Mastrangelo et al (6,136,212) and Frazier (5,871,158), as applied above to claim 9, and further of Mastrangelo (5,258,097).

Mastrangelo '212 and Frazier fails to disclose the multiplicity of holes extending through the sacrificial layer to the floor layer, depositing of the ceiling layer in the holes to define obstacles in the working gaps; and removing of the sacrificial layer between the obstacles in the working gap to produce an artificial gel.

Mastrangelo '097 discloses the multiplicity of holes extending through the sacrificial layer to the floor layer (col 4, lines 9-17), depositing of the ceiling layer in the holes to define obstacles in the working gaps (col 2, lines 21-30; col 4, lines 35-53), and removing of the sacrificial layer between the obstacles in the working gap to produce an artificial gel (col 5, lines 45-50).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the method of Mastrangelo '212' to form the multiplicity of holes extending through the sacrificial layer to the floor layer, to deposit of the ceiling layer in the holes to define obstacles in the working gaps, and to remove of the sacrificial layer between the obstacles in the working gap to produce an artificial gel, as taught by Mastrangelo '097 in order to provide structural support for the ceiling layer against capillary forces.

Art Unit: 2822

8. Claim 35 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mastrangelo et al (6,136,212) and Lin (5,591,139), as applied above to claim 30, and further of Frazier (5,871,158),

Mastrangelo as modified fails to disclose the forming of further fluidic devices on top of the already formed fluidic system and forming interconnects therebetween.

Frazier discloses the forming of further fluidic devices on top of the already formed fluidic systems and forming interconnects therebetween (col 7, lines 2-8,30-41).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the ceiling and sacrificial layers of Mastrangelo to form multilevel working gaps as taught by Frazier to allow different fluids to flow through different channels. Furthermore, the duplication of prior art process to accomplish an expected additive function or result is prima facie obvious absent a disclosure that the process is for a particular unobvious purpose, produces an unexpected result, or is otherwise critical.

9. Claim 36 is rejected under 35 U.S.C. 103(a) as being unpatentable over Mastrangelo et al (6,136,212) and Lin (5,591,139), as applied above to claim 30, and further of Vaeth (US2001/0005527).

Mastrangelo as modified fails to disclose the layers being formed using chemical vapor deposition.

Vaeth discloses the layers being formed using chemical vapor deposition (paragraph 9).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the method of Mastrangelo to form the layers using chemical vapor deposition process as taught by Vaeth in order to use a method the produce a relatively thin polymer layer with no holes therein.

Allowable Subject Matter

*** Claim 24 is allowed for the reasons as of record.

*** Claims 8 and 19 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Art Unit: 2822

Response to Amendment

10. Applicant's remarks filed May 29, 2003 with respect to pending claims have been considered but are moot in view of the new ground(s) of rejection.

*** Applicant remarked that in Tai et al, "They are not patterned to define 'the shape of a desired fluid working gap...'"

In response, this is noted and found unconvincing. In Tai et al, at least the silicon sacrificial layer 333 is deposited and patterned to define a shape of a desired fluid working gap.

*** Re claims 25 and 43, Applicant remarked that the channel of Tai et al is formed on the micrometer scale.

In response, this is noted and found unconvincing. Renumbered claim 43 recites 1000nm. Thus, it is micrometer scale or nanometer scale, since 1000nm equals to 1 micron.

*** Applicant apparently remarked that Mastrangelo teaching the "polymer based micromachining process" while Tai teaches a silicon based processes which is directly against the teaching of Mastrangelo et al.


In response, it is noted and found unconvincing. Mastrangelo teaches both systems including "polymer based micromachining process" and "silicon based processes", and preferably to use the polymer based processes to form the system. Although each processes has advantages and disadvantages, it is totally different from teaching away for not using one "silicon based process". Indeed, Tai teaches using polysilicon layer as the sacrificial layer, wherein a fluidic flow channel working gap is formed between a floor layer and a ceiling layer by removing the polysilicon sacrificial layer.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Michael M. Trinh whose telephone number is (703) 308-2554. The examiner can normally be reached on M-F from 8:30 Am to 4:30 Pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on (703) 308-4905. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Oacs


Michael Trinh
Primary Examiner